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## DETERMINATION OF WATER VAPOUR DIFFUSION ACROSS BRICK MASONRY TREATED WITH WATER-REPELLANT SEALERS

### Introduction

The ability of commercial water repellants to allow for water vapour diffusion across treated masonry such as brick assemblies is an important criterion in the selection of a water repellant. Unfortunately, no standard test exists to determine the rate of water vapour diffusion across such materials. Standardized industry tests, which have been designed to determine water diffusion rates across uniform sheet materials, are not suitable for brick masonry assemblies.

As part of a CMHC research project, Patenaude Consultants of Varennes, Quebec, developed a unique, experimental test for evaluating the rate of water vapour diffusion across masonry assemblies treated with various water-repellant products.

The main objectives of the project were to develop a practical method to conduct the evaluation and to compare the effectiveness of the various water-repellant products used. The consultants evaluated six masonry assemblies in both high and low humidity environments.

Five of the assemblies were treated with different commercial water repellants. The sixth assembly, which was untreated, served as a control sample.

This project had a short-term focus. To determine the longer-term effects of the water repellants, the masonry assemblies are currently being weathered in an exterior location. After a period of one year, they will be returned to the laboratory for retesting in 2001.

### Research Program

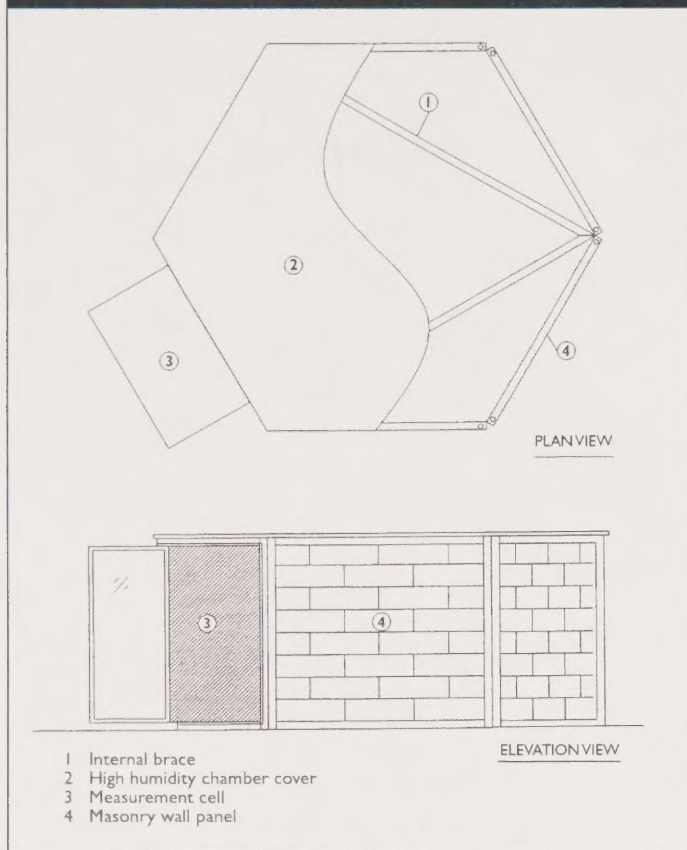
#### Apparatus

The consultants created a unique test apparatus to conduct the experiment. It consisted of steel test-frames comprising a hexagon-shaped enclosure that held the six masonry assemblies. The treated side of the masonry panels formed the exterior of the hexagon (see Figure 1).





**Figure 1: Overview of specimen placement and environment chambers.**



The apparatus included a movable measurement cell to measure the vapour transmission characteristics of each panel. This measurement cell was a lined box in which trays of desiccant were placed over a sensitive electronic balance. The measurement cell was sealed to the surface of each test sample in turn.

The desiccator, through which two circulating fans forced air, maintained the low-humidity environment within the test cell. A vapour generator produced the necessary high-humidity environment within the hexagonal test chamber.

In addition, independent sensor and data collection systems monitored and recorded the temperature and humidity conditions in three humidity environments (high humidity, low humidity and ambient air).

A computer regularly retrieved data from these sensors. Another system collected data from the measurement cell showing changes in the weight of the desiccant due to vapour flow.

### Test procedure

To determine the rate of vapour diffusion through the masonry assemblies, the researchers used a multi-step process.

The masonry test panels were first assembled, then conditioned for a period of 30 days. During this period, the mortar was allowed to cure and the samples to dry before being tested. After the conditioning period, the test panels were linked to form the sides of a closed hexagon.

The water-repellant products were then applied to the panels. To protect client confidentiality, the products applied to the test panels were identified by their generic chemical description as follows:

- Panel A: 40% silane (solvent based)
- Panel B: Polysiloxane blend (solvent based)
- Panel C: Silane/polysiloxane blend (water based)
- Panel D: Siloxane/silane blend
- Panel E: Elastomeric waterproof coating
- Panel F: Control panel (no coating)

The measurement cell was fixed to the steel frame of the test panel, and the humidity generator and blower assemblies were activated to produce the necessary humidity conditions across the hexagon and balanced to nullify static air pressure differences across the test specimen.

Following a preconditioning period, in which a steady state of vapour diffusion was achieved, the researchers installed a precision electronic balance within the measurement cell with a desiccator mounted over its measuring pan. At regular hourly intervals, a data acquisition system recorded the weight gain of the desiccator.



When the data indicated a constant rate of weight gain, the test was concluded. At this point, the weight data generated from the precision balance and the data stored on the relative humidity and temperature sensors were collected for processing. The measurement cell was then removed and attached to the next test panel.

### Measurement of results

The evaluation of the product performance used the rate of weight change in the quantity of desiccant as a means of determining the rate of vapour transmission.

Based on the temperature and relative humidity data for the three humidity environments being monitored, the researchers determined the partial vapour pressures for these environments and used them to calculate the gross vapour flow rate into the measurement cell. This value was corrected for gains due to leakage across the measurement cell's seals.

Once all the masonry assemblies had been tested, they were removed from the hexagonal frame and moved to the exterior location for weathering.

### Findings

Based on the information gathered and the researchers' calculations, the researchers ranked the performance of the water-repellant products. The ranking showing the products in order of decreasing Water Vapour Transmittance (WVT) for the two test conditions is shown in Table 1.

**Table 1: Ranking of Applied Water Repellants as to Breathability I (%)**

@ Low Vapour Pressure Difference	@ High Vapour Pressure Difference
C: 86	A: 118
A: 83	B: 111
D: 79	D: 103
B: 72	C: 98
E: 72	E: 85

(1): Breathability was determined in comparison to control sample F.

- Panel A: 40% silane (solvent based)
- Panel B: Polysiloxane blend (solvent based)
- Panel C: Silane/polysiloxane blend (water based)
- Panel D: Siloxane/silane blend
- Panel E: Elastomeric waterproof coating
- Panel F: Control panel (no coating)

Three of the water repellent/panel combinations (E, D and A) maintained their general ranking under both low and high-humidity conditions. The ranking of panels B and C changed for the two conditions. However, given the close grouping of the results, no definite conclusions about the relative performance of the individual products was possible.

### Implications for the Housing Industry

The results and analysis indicate that the application of the five water-repellant products had no significant effect on the vapour-diffusion characteristics of a masonry wall assembly when compared to an untreated specimen.

Although the study proved successful, more research is required to produce results that are more definitive. In addition, the report notes that the test procedure, which is time-consuming, could be improved by accelerating it wherever possible. The report also recommends that future investigators consider alternate measurement methods that could prove to be more efficient and expedient.

**CMHC Project Manager:** Jacques Rousseau

**Research Report:** Determination of Water Vapour Diffusion Across Brick Masonry Treated With Water Repellant Sealers, 2000

**Research Consultant:** Armand Patenaude, Patenaude Consultants Inc.

A full report on this project is available from the Canadian Housing Information Centre at the address below.

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